Haque *et al.*
Bulletin of Faculty of Physical Therapy (2024) 29:39
https://doi.org/10.1186/s43161-024-00197-4

Bulletin of Faculty of Physical Therapy

ORIGINAL RESEARCH ARTICLE

Open Access

Effects of Android phone vs. iPhone use on BlackBerry thumb symptoms among university students in Bangladesh

Md Ariful Haque[1,2], Liton Baroi[3*], Ismat Ara Chowdhury Koly[4], Md Shakibul Hasan[5], Faiza Mahmud[6], Sifat Ara Eva[7], Moinul Karim Labib[6], Hazika Tuz-Zohura Nafisa[8], Salwa Islam[9], Irfat Islam Eva[10], Md. Rafiqul Islam[11], Lita Bose[12] and Faming Tian[13]

Abstract

Background In Bangladesh, the most prevalent musculoskeletal condition among office employees is considered as BlackBerry thumb (BBT). Alike official perspectives, our educational system was significantly regulating with the digital interfaces at COVID-19 lockdown, where a greater reliance on Android phones were experienced among the adults. Numerous studies have been conducted in studying the incidences of BBT in young individuals as a result of hazards of Android phone usage (HAPU) in Bangladesh.

Objective This research sought to determine the relationship between BBT symptoms and the risks associated with the using Android phones among Bangladeshi university students.

Methods A nationwide cross-sectional study was undertaken on a group of university students between the ages of 18 and 25 to determine if BBT symptoms were present based on the Finkelstein test and HAPU, which were also assessed using a well-designed questionnaire. We calculated the crude and adjusted prevalence ratios (aPR) and used a generalized linear model from the Poisson family, using their respective 95% confidence intervals (CI).

Results There were 2455 individuals in this research, with a median age of 20 and an interquartile range (IQR) of 19 to 23. Of them, 1185 males (48.27%) and 1270 women (51.75%) made up the study's participant population. Physical exams showed that 1300 individuals had positive Finkelstein test results (52.95%), whereas 1040 people had occasional risks from using an Android phone and 115 participants had occasional risks from using an iPhone. In our generalized linear model, we observed that participants with occasional and frequent HAPU had higher rates of BBT symptoms than responders without HAPU (*aPR* = 1.73, 95% *CI*: 1.47–2.05, and *aPR* = 1.61, 95% *CI*: 1.29–2.00), respectively.

Conclusion The current study found that Bangladeshi university students experiencing BlackBerry thumb symptoms were more likely to have risks associated with using Android phones.

Keywords BlackBerry thumb, De Quervain disease, Smartphone, Android phone, University students, Bangladesh

*Correspondence:
Liton Baroi
litonbaroi0991@gmail.com
Full list of author information is available at the end of the article

Introduction

The COVID-19 outbreak and the lockdown guidelines worldwide have bought about some major challenges socially, economically, physiologically, and psychologically in people's lives. One significant lifestyle shift was the aggravated use and reliance on Android phones to access information, as an educational platform, means of communication, and entertainment [1]. The posture of smartphone usage requires fixing the device with hands, looking at the device, and repetitive and consistent thumb and wrist movements [2]. Prolonged duration and frequency of Android phone use with frequent movement of the upper limbs are major risk factors for musculoskeletal manifestations [3], such as BlackBerry thumb [3]. Prolong or repetitive body movements are highly responsible for musculoskeletal pain [4–6]. In this pandemic, many of one affected on musculoskeletal disorder directly or indirectly in Bangladesh [7].

BlackBerry thumb is a painful inflammatory condition involving the tendons of the abductor pollicis longus and extensor pollicis brevis in the first dorsal compartment. Although the BlackBerry thumb syndrome origin is debatable, it is attributed to myxoid degeneration with fibrous tissue deposits and increased vascularity [3]. A positive Finkelstein test may be used for the diagnosis of this condition [8]. BlackBerry thumb syndrome is often associated with repetitive wrist movements, specific motion requiring thumb radial abduction, and simultaneous extension and radial wrist deviation [8]. Blunt trauma, biomechanical compression, overexertion from repetitive work activities, anatomical variations or abnormalities, genetic predisposition, cold temperatures, and pathogens are said to be some of the potential causes of BlackBerry thumb [8]. The predicted BlackBerry thumb prevalence is 0.5% and 1.3% for men and women respectively [15], with peak prevalence among the younger generation [9].

During the COVID-19 pandemic, preventive measures such as countrywide lockdowns, social distancing, closure of educational institutes, and restrictions in movements to limit the spread of the virus have led to a drastic increase in the usage of smartphones to access information, purchase essential products, and seeking medical counseling, as a source of communication and entertainment [2], which eventually directed to rise in reliance and addiction to smartphones and devices. Many of news spared through social media which made negative impact on population for vaccination in Bangladesh [10]. Studies have reported that during COVID-19, Android phone addiction increased from 26.1 to 46.7%, compared to the pre-epidemic period in children and adolescents. Moreover, the usage of Android phones multiplied to 8–12 h per day among medical students. Hazards of Android phone use were associated with an increase in daily Internet use time among university students [11]. Furthermore, the time spent on social media apps such as Facebook, Twitter, and Instagram has increased, females were found to spend more time on social media and launching social media apps than males, and the use of gaming apps on Android phones has increased exponentially since the pandemic [11].

The frequent and unrestrained use of Android phones during COVID-19 is not only deleterious to psychological health but is attributable to a musculoskeletal disorder such as BlackBerry thumb [12], due to repetitive strain injuries caused by repeatedly pressing their thumbs or using a combination of thumb/finger motions. It was reported the incidence of BlackBerry thumb increased by overuse of the thumb muscle during prolonged Internet browsing, frequent texting, and gaming on Android phones [12]. Several studies have reported the prevalence of BlackBerry thumb among Android phone users, and Iqbal et al. stated that more than half of the undergraduates (58.1%) using Android phones had BlackBerry thumb with the 67% of the people who used the Android phone for texting tested positive for Finkelstein's test whereas found 19.1% Android phone users tested positive for Finkelstein's test, and pain was positively correlated with the degree of smartphone use [13]. Woo et al. reported that overuse of smartphones and gadgets puts excessive force on the median nerve and leads to nerve compression if repetitive movements persisted for longer periods [14]. Additionally, on average, musculoskeletal complaints were usually made by people who used Android phones for more than 3 h, providing insights into how BlackBerry thumb can be a common phenomenon among Android phone users [14].

Ever since the COVID-19 pandemic, smartphone dependency has increased immensely which has become an emerging cause for BlackBerry thumb among people. Although there have been several studies that linked BlackBerry thumb with smartphone usage, there has been a dearth of studies that assessed the prevalence of BlackBerry thumb among smartphone users during COVID-19. Hence, it is imperative to conduct research that further explores the incidence of BlackBerry thumb during COVID-19 among Android phone users. The present study aimed to assess the occurrence rate and explore the risk factors of BlackBerry thumb among smartphone users during COVID-19, which will help in early diagnosis and appropriate management of BlackBerry thumb possible.

Methods

Study design

A comprehensive cross-sectional investigation was conducted on a group of university students between the ages of 18 and 25, especially those who spend around 4.15 h on average in cell phones everyday, and have been using mobile phone for at least 4 years. In the districts of Dhaka, Chattagram, Rajshahi, Khulna, Sylhet, Barishal, Mymensingh, and Rangpur, both state and private colleges were surveyed. The colleges were chosen to improve the likelihood of locating participants who fit the necessary years of age and possess cell phones. The survey was conducted between August 2022 and May 2023.

Subjects and sampling

People who used a cell phone with a minimum of two social networking platforms, like Facebook, WhatsApp, Instagram, or Twitter, were eligible to engage in the research. Participants with thumb or wrist injuries in the 3 months before the assessment, those who used a painkiller medication in the final week before the evaluation for any reason, and those working in jobs with an increased BBT danger were eliminated. Figure 1

A preliminary research study involving 50 participants yielded the data required to calculate the size of the sample. There were 36% (18/50) cases of sporadic or regular HAPU. A total of 32% (10/32) of those in the group who did not use HAPU had significant BBT signs and symptoms, compared to 45% (8/18) of those who used HAPU frequently or occasionally. An initial sample of 468 individuals would be required to identify prevalence ratios greater than 1.4 with an 80% statistically significant level of power using these values and a 95% confidence level. After adding 4% to account for the potential for incomplete responses, the total sample size, which was selected employing a non-probabilistic method of sampling, was 488 people.

In determining the sample size, Krejcie and Morgan method [15] was considered:

$$n = \frac{\chi^2 NP(1-P)}{d^2(N-1) + \chi^2 P(1-P)}$$

Here,

n = the sample size, N = population size, P = population portion (if unknown then 0.5), d^2 = desired margin of error (expressed as portion), and χ^2 = chi-square for specified confidence level at 1 degree of freedom [15].

Variables considered

The existence or lack of BBT symptomatology was our outcome variable, and it had two groups. The Finkelstein test, which measures the prevalence of symptoms of tenosynovitis in the extensor pollicis brevis and the abductor pollicis longus tendons, was used to analyze the result. The wrist must stay at the end of the bench on the instructor's side, while the forearm is extended and rotated in neutral during the Finkelstein test. The subject was then instructed to deviate their wrist, and the evaluator then grabbed their thumb and passively and aggressively flexed it into their hand. The Finkelstein test was carried out on both the dominant and nondominant wrists and is deemed affirmative if the subject reports

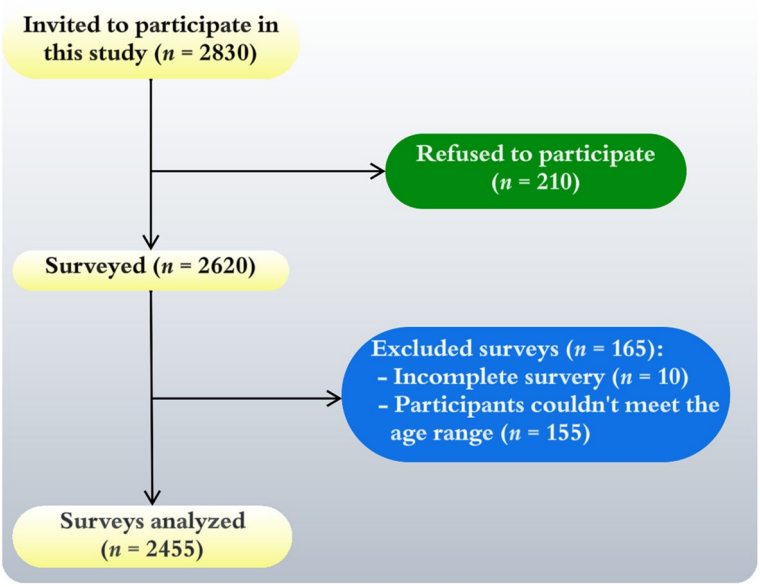

Fig. 1 Diagrammatic illustration of the process used to choose the participants for the study

pain to us [16]. We utilized it for testing in determining the presence of BBT because the EU Handguide Group identified it as the most effective test for this reason concerning this issue [16]. In a prospective cohort study with a 3-year follow-up, ultrasonographic and clinical assessments of 100 patients' positive Finkelstein test findings were contrasted. The test's sensitivity was determined to be 89% and its specificity to be 14% [17].

The observations similar to the cell phone device use survey, which asks about the use of and reliance on this technology, were used to assess the HAPU [18]. Ten elements make up the test, which has a Cronbach's alpha of 0.81 and a maximum result of 40 points. Thus, we divide the participants into three groups: (a) those absent of HAPU (10 to 15 points), (b) those with infrequent HAPU (16 to 23 points), and (c) those with recurrent HAPU (from 24 to 40 points). We chose to utilize the three categories provided by the modalities for the study's objectives, so we split up the entire population into the three research groups.

Data collection

Before the data gathering, the Finkelstein maneuver instruction with a health expert was done to standardize the evaluators. Before the research started, a pilot study with 50 participants was carried out to determine the participants' general level of understanding of the topics and the study's average completion time. Then, our research team went to the colleges to invite the target audience. The proportion of participants who did not respond as well as their age, gender, and occupation was recorded to assess the possibility of selection bias. The participants orally gave their informed permission before starting their participation in the study. The first stage of the poll was then carried out using the cell phone device—the surrounding experiences questionnaire. The Finkelstein maneuver was then carried out, followed by a short discussion of protective ergonomic advice and wrist pain management tips.

To guarantee a higher poll count and prevent potential losses due to lost or erroneous data input, all the collected data was separately moved to Excel without IDs.

Statistical analysis

The statistical analysis of the quantitative variables was conducted using STATA v. 14 (StataCorp, Texas, USA). In contrast to quantitative variables, which were portrayed as medians alongside an interquartile range if they had irregular distributions or as means with standard deviation if they had symmetric distributions, qualitative variables were depicted as absolute and relative rates. One-way analysis of variance was applied when comparing number factors with uniform distributions; otherwise, the Kruskal–Wallis test was applied. To assess the qualitative variables, the chi-square test was employed. The aim of the research was evaluated using an improved linear model from the Poisson family with trustworthy standard deviations. Prevalence ratios (PR) in their raw and modified forms, along with corresponding 95% confidence intervals (CI), were given [19, 20]. The modified model contained the previously chosen confounding factors. After studying the scholarly literature, the following factors were determined to be confounding factors: years of age; gender; hours of usage of cell phone device per day; the number of messages delivered per day; previous week's history of inflammation due to cell phone device use; use of social networking platforms such as Instagram, Twitter, Facebook Messenger, and WhatsApp; use of digital video games; and use of the Internet. Similarly, the confounding factors' collinearity associations concerning the variables chosen to be included in the modified model were assessed. The results obtained from both the qualitative and quantitative measurements were further analyzed for verifying the statistical precision using GraphPad Prism 8.1.2 [21–23] and R-Studio [24–26]. In that cases, two-way ANOVA [27–29] and Tukey's *t*-test for multiple variable analysis were preferred [30–32].

Result

In this study, 2455 participants were included out of 2830 invited. The median age was 20 (*IQR*: 19–23), with 48.27% men and 51.75% women. Participants spent a median of 6 h per day on their cell phones, sending an average of 200 messages daily. The most popular platforms were WhatsApp, Facebook, and Facebook chat, with 90.63%, 90.63%, and 88.80% users respectively. Additionally, Twitter, Instagram, video games, and Internet were used by 54.18%, 64.56%, 43.58%, and 45.82% of participants. The hazards of Android phone use were assessed using the ERMUQ, resulting in a median score of 15 (range: 12–18). Half of the respondents were non-hazardous Android phone users (52.95%), while 42.36% had occasional hazards and 4.68% had frequent hazards. Physical examinations showed 52.95% positive Finkelstein test results. Additionally, 37.88% reported pain due to mobile phone use in the last week (Table 1).

Association of the study variables with hazards of Android phone use

The study included 1300 participants, with 51.54% men and 48.46% women, and a median age of 20 (*IQR* = 19–23). Most participants did not show hazards of Android phone use (HAPU). Among those with occasional HAPU, there were more females than males, and they spent an average of 12 h per day on their phones. Frequent HAPU was more common in females, with

Table 1 General characteristics of the sample included in the study

Variables	*N* = 2455 (%)
Age (years)	20 (19–23)
Male	1185 (48.27)
Variables related to Android phone use	
Number of hours using the Android phone per day	6 (4–10)
Number of messages sent per day	200 (50–500)
Use of social networks and Internet	
WhatsApp	2225 (90.63)
Facebook	2220 (90.63)
Facebook chat	2180 (88.80)
Twitter	1330 (54.18)
Instagram	1585 (64.56)
Video games	1070 (43.58)
Internet	1125 (45.82)
Hazards of Android phone use	
ERMUQ questionnaire (total score)	15 (12–18)
No problems with Android phone use	1300 (52.95)
Occasional problems with Android phone use	1040 (42.36)
Frequent problems with Android phone use	115 (4.68)
Positive Finkelstein test	1300 (52.95)
Pain due to the use of the Android phone in the last week	930 (37.88)

Median (interquartile range). *ERMUQ* Experiences Related to Android Phone Use Questionnaire

longer daily phone use and higher message counts. Pain due to smartphone usage was reported by a minority of participants, with higher prevalence among those with HAPU. The main online platforms used were WhatsApp, Facebook, Facebook chat, Twitter, Instagram, video games, and the Internet (Table 2). The prevalence of occasional HAPU among users of various online platforms was highest for Facebook, Facebook chat, and WhatsApp, while the prevalence of frequent HAPU was highest for WhatsApp, Facebook, and Facebook chat (Table 2).

Association of the variables with the result of the Finkelstein test

The physical examination of participants showed that 52.95% had a positive Finkelstein test, with a median age of 20 (*IQR* = 19–22), while 47.05% had negative results, with a median age of 21 (*IQR* = 19–23). Those with positive results spent an average of 8 h per day on their phones and sent an average of 300 messages per day, compared to 5 h per day and 150 messages per day for those with negative results. The majority of those with positive tests reported wrist pain due to phone use, and they were more frequent users of online applications and the Internet compared to those with negative results (Table 3).

Generalized linear model crude and adjusted prevalence ratio for the association between hazards of Android phone use and the positive Finkelstein test

The participants with occasional hazards of Android phone use had a crude prevalence ratio (cPR) of 2.08 and an adjusted prevalence ratio (aPR) of 1.73, while those with frequent hazards of Android phone use had a cPR of 2.52 and an aPR of 1.61, with participants having no HAPU as the referent category. Variables related to Android phone use showed significant associations, with the number of hours using the cell

Table 2 Distribution of the study variables according to hazards of Android phone use

Variables	No HAPU (*N* = 1300)	Occasional HAPU (*N* = 1040)	Frequent HAPU (*N* = 115)	*p*-value
Age (years)	20 (19–23)	20 (19–22)	19 (18–20)	< 0.01
Male	670 (51.54)	480 (46.15)	35 (30.43)	0.11
Variables related to Android phone use				
Number of hours using the Android phone per day	6 (4–8)	7 (4–10)	12 (5–18)	< 0.01
Number of messages sent per day	200 (50–400)	178 (40–600)	700 (300–1000)	< 0.01
Pain due to the use of the Android phone in the last week	400 (30.77)	460 (44.23)	70 (60.87)	< 0.01
Use of social media and Internet				
WhatsApp	1190 (91.54)	920 (88.46)	115 (100)	0.15
Facebook	1175 (90.38)	935 (89.90)	110 (95.65)	0.67
Facebook chat	1185 (91.15)	890 (85.58)	105 (91.30)	0.15
Twitter	670 (51.54)	595 (57.21)	65 (56.52)	0.46
Instagram	765 (58.85)	735 (70.67)	85 (73.91)	0.02
Video games	560 (43.08)	445 (42.79)	65 (56.52)	0.44
Internet	595 (45.77)	465 (44.71)	65 (56.52)	0.56

Median (interquartile range), number (percentage). *HAPU* hazards of Android phone use

Table 3 Distribution of the variables according to the result of the Finkelstein test

	Positive (*N* = 1300)	Negative (*N* = 1155)	*p*-value
Age (years)	20 (19–22)	21 (19–23	0.03
Male	625 (52.74)	560 (47.26)	0.93
Variables related to Android phone use			
Number of hours usin the Android phone per day	8 (5–12)	5 (4–8)	< 0.01
Number of messages sent per day	300 (60–600)	150 (50–340)	< 0.01
Pain due to the use of the Android phone in the last week	830 (89.25)	100 (10.75)	< 0.01
Use of social networks and Internet			
WhatsApp	1195 (53.71)	1030 (46.29)	0.30
Facebook	1195 (53.71)	1030 (46.29)	0.65
Facebook chat	1135 (52.06)	1045 (47.94)	0.27
Twitter	670 (50.38)	660 (49.62)	0.21
Instagram	900 (56.78)	685 (43.22)	0.02
Video games	615 (57.48)	455 (39.39)	0.07
Internet	645 (57.33)	480 (42.67)	0.07

Median (interquartile range), number (percentage)

phone per day and pain due to smartphone use in the last week having notable adjusted prevalence ratios. Additionally, specific online platforms such as WhatsApp and Instagram also showed significant associations (Table 4).

Discussion

This study examined the prevalence and causative factors of BlackBerry thumb among Android phone users during the COVID-19 pandemic and revealed that 52.95% tested positive for BlackBerry thumb using the Finkelstein test as a standard diagnostic test. This study's findings are similar to those of Bendezu-Quispe et al., who found that 53% of young adults who used the same diagnostic test had positive results [33]. General characteristics (age, gender), variables related to Android phone use (hours using the smartphone per day, messages sent per day), frequently used social networks, hazards of Android phone use and their distribution according to variables, the Finkelstein test result distributions, the association

Table 4 Generalized linear model crude and adjusted for the association between hazards of Android phone use and the positive Finkelstein test

Variables	Crude PR (95% *CI*)	*p*-value	Adjusted PR (95% *CI*)	*p*-value
No hazards of Android phone use	Ref		Ref	
Occasional hazards of Android phone use	2.08 (1.73–2.51)	< 0.01	1.73 (1.47–2.05	< 0.01
Frequent hazards of Android phone use	2.52 (1.99–3.16)	< 0.01	1.61 (1.29–2.00)	< 0.01
Age (years)	0.96 (0.92–0.99)	0.02	0.98 (0.95–1.02)	0.39
Male	0.99 (0.84–1.17)	0.92	1.05 (0.92–1.21)	0.47
Variables related to Android phone use				
Number of hours using the Android phone per day	1.05 (1.04–1.07)	< 0.01	1.02 (1.01–1.04)	< 0.01
Number of messages sent per day	1.00 (0.99–1.01)	0.52	1.00 (0.99–1.01)	0.37
Pain due to the use of the *Android phone* in the last week	2.89 (2.43–3.45)	< 0.01	2.68 (2.25–3.18)	< 0.01
Use of social networks and Internet				
WhatsApp	1.18 (0.85–1.63)	0.33	1.63 (1.24–2.13)	< 0.01
Facebook	1.01 (0.77–1.33)	0.93	-	-
Facebook chat	0.86 (0.69–1.10)	0.23	0.72 (0.55–0.94)	0.02
Twitter	0.90 (0.76–1.06)	0.21	0.77 (0.67–0.89)	< 0.01
Instagram	1.23 (1.02–1.49)	0.03	1.15 (0.97–1.36)	0.10
Video games	1.16 (0.98–1.37)	0.08	1.06 (0.91–1.23)	0.44
Internet	1.16 (0.99–1.38)	0.07	1.07 (0.93–1.23)	0.32

CI confidence intervals, *Ref* reference, *PR* prevalence ratio. The variable Facebook does not enter the model adjusted for being collinear with the variable WhatsApp

between hazards of Android phone use, and the positive Finkelstein test were observed among Android phone users, with a significant association found with BlackBerry thumb [33].

In our study, the majority of the participants were women (51.75%) with a median age of 20, and in another review article, Morgan et al. perceived that females mostly experienced BlackBerry thumb in the age group of 16–20 years (89%) [34]. Participants spend 6 (4–10) median hours on Android phones while texting 200 (50–500) messages per day in our study, while Ali et al. found that 56% of students text more than 50 messages per day. According to Alexander et al., WhatsApp is a condition caused by excessive use of the popular instant messaging app and characterized by typical wrist pain, is a new emerging disease, and is also known as BlackBerry thumb or tenosynovitis [35]. Additionally, Facebook chat, Twitter, Instagram, and the Internet were frequently used for social communications, connections, and collecting the latest information around the world during the pandemic in our study. According to Katz and Nandi, these social networking sites helped to provide formal and informal education, discussion groups, and physician and patient consultations [36]. Chan et al. expressed that social media played a vital role in the dissemination of knowledge during the COVID-19 pandemic [36]. Based on the Experiences Related to Mobile Phone Use Questionnaire (ERMUQ), the participants' median score was 15, and those who faced occasional and frequent Android phone usage problems were 42.36% and 4.68%, respectively. A total of 37.88% of participants complained of pain due to Android phone use in the last week; on the other hand, 42% of participants experienced thumb or wrist pain, according to Ali and his teammates [10]. The prevalence of BlackBerry thumb among smartphone users of different university students in Lahore was 55%, and this study was conducted by Tahir and Ahmad [37].

Association of the study variables with hazards of Android phone use

The participants who had occasional and frequent problems with Android phone usage were mostly female, and their frequency was 53.85% and 69.57%, respectively. Long et al. revealed that the overall prevalence of hazards of Android phone use (HAPU) in their study was 21.3% among whom 53.1% were female [38]. The average age of no HAPU and occasional HAPU participants was 20, while the average age of frequent HAPU participants was 19, which is significant. In our study, participants with occasional and frequent HAPU spent 7 and 12 median hours per day, while those without HAPU spent 6 median hours per day; on the other hand, 52.4% of students, who had HAPU, used more than 4 h per day in a study done by Long et al. [38]. Our study revealed that frequent HAPU-experienced participants sent 700 texts per day, and among them, 60.87% experienced pain last week due to their smartphones. At the same time, occasional and no HAPU sent 178 and 200 texts per day, respectively, while 44.23% and 30.77% of them experienced pain. Sarfraz et al. discovered that 39.8% of university students had mild pain, 73 (38.2%) had moderate pain, and 4 (2.1%) had severe pain [39]. WhatsApp was widely used by all HAPU groups, particularly by all frequent HAPU users. Facebook, Facebook chat, and Instagram were highly used by all categories of HAPU, and the percentage varies from 85 to 92%. Twitter, video games, and users ranged from 42 to 58% among all types of HAPU. A study conducted in Bangladesh during the COVID-19 pandemic by Hosen et al. revealed that 96.7% of participants remained online for messaging at the same time that 95.5% and 92.5% of students used Android phones for social media browsing and video watching respectively, among hazards of Android phone users [11]. In another study conducted by Marengo et al., they found a positive association between hazards of Android phone usage and social networking sites like WhatsApp, Facebook, Facebook chat, and Instagram [40].

Association of the variables with the result of the Finkelstein test

Participants who showed positive test results of the Finkelstein test were 1300; among the male and female participants, 52.74% and 53.15% were positive, respectively, and the median age was 20 years. On the other hand, Ahmed et al. found that the participants' overall median age was 22.0 years [41], and among those who showed positive test results of the Finkelstein test, 66.5% were female. Participants who received a positive test result spent an average of 8 (*IQR* 5–12) h per day on their smartphones, sending an average of 300 (*IQR* 60–600) text messages, which was a very significant number. A study conducted by Ahmed et al. found that 23.7% of positive respondents spent more than 8 h per day, and 15.2% sent more than 200 test messages per day [41]. The respondents to our study who tested positive and experienced pain last week were 89.25%, and this was a very significant number. Another study by Baabdullah et al. found that excessive use of smartphones and smartphone addiction lead to pain in the thumb/wrist [42]. The percentage of participants who used WhatsApp, Facebook, Facebook chat, Twitter, Instagram, the Internet, and video games varies from 50 to 58%, while the percentage of participants who used negative test results varies from 39 to 50%. Shen et al. conducted a study on mobile gaming and found that it can be one of the potential risk factors for De Quervain's tenosynovitis [43]. According to

Bendezu-Quispe et al., higher detection of De Quervain's tenosynovitis correlated with the number of hours spent on a smartphone [33], WhatsApp usage, and experiencing pain last week due to a smartphone.

Generalized linear model crude and adjusted prevalence ratio for the association between hazards of Android phone use and the positive Finkelstein test

We used a generalized linear model to calculate a crude and adjusted prevalence ratio for different variables. In this model, we used no HAPU group as a reference to find the association between hazards of Android phone users and the positive Finkelstein test. The crude prevalence ratio (cPR) and adjusted prevalence ratio (aPR) for the occasional HAPU were 2.08 and 1.73, respectively, and the frequent HAPU were 2.52 and 1.61, respectively, and these have significant *p*-value. Fischer-Grote et al. found no strong evidence for age or gender as potential risk factors for developing BlackBerry thumb and HAPU [44]. With a significant *p*-value, the number of hours spent on a cell phone per day had a cPR of 1.05 and an aPR of 1.02. The prevalence of positive Finkelstein test increased with the time spent on smartphones, as found by Reada and the team [8]. The cPR and aPR for the respondents who experienced pain due to the use of the smartphone in the last week were 2.89 and 2.68, respectively, and they had a significant *p*-value. According to Zirek et al. [45], the prevalence of BlackBerry thumb, other musculoskeletal complaints, and pain could be increased because of extended computer and electronic gadget usage, professional demands like athletes, medical professionals, and others. In our study, the number of messages sent per day had the same cPR and aPR, which is 1.00. Different social networking sites and the Internet had different cPR and aPR, but they did not have any significant *p*-value in our study, while another done by Long et al. expressed that social networking, playing video games, and Internet surfing might lead to HAPU and increase the prevalence of BlackBerry thumb [38]. Frequent usage of social networking media might influence the increment of hazards of Android phone usage suggested by Marino et al. [46].

This study focused on the prevalence of BlackBerry thumb among smartphone users in Bangladesh during the pandemic. This study had some limitations, as they were not able to cover all the possible risk factors due to time and resource constraints, and the participants' responses might be affected by recall bias and their psychological status. Further study is required to develop a deeper understanding of the potential risk factors and their association with BlackBerry thumb to provide awareness, education, and effective interventions.

Conclusion

The current study addresses the elevated prevalence of "BlackBerry thumb" among users of Android phones, detected through the Finkelstein test. An investigation scrutinized the hazards linked to Android phone usage, sociodemographic traits, and factors like daily phone usage duration and discomfort. The study revealed noteworthy associations between positive Finkelstein test outcomes and factors associated with Android phone usage, underscoring the necessity for a more extensive inquiry to substantiate findings and promote awareness.

Abbreviations

BBT	BlackBerry thumb
HAPU	Hazards of Android phone usage
PR	Prevalence ratios
aPR	Adjusted prevalence ratios
cPR	Crude prevalence ratio
CI	Confidence intervals
IQR	Interquartile range
EU	European Union
ERMUQ	Experiences Related to Mobile Phone Use Questionnaire

Acknowledgements

The authors are grateful to the RPG Interface Lab Authority for providing all unconditional support in statistical software tools, grammatical checking, and plagiarism issues. We also acknowledge Dr. Salauddin Al Azad for language editing the final paper and Dr. Sharmin Ahmed for help with back-translating the study questionnaire.

Authors' contributions

Md Ariful Haque, Liton Baroi, Ismat Ara Chowdhury Koly, Shakibul Hasan, Faiza Mahmud, Sifat Ara Eva, Monirul Karim Labib, Hazika Tuz-Zohura Nafisa, Salwa Islam, Irfat Islam Eva, Rafiqul Islam, Lita Bose, Faming Tian was involved in the conceptualization of the study, the formal analysis and visualization of the data as well as writing the original manuscript draft. Dr. Sharmin Ahmed was involved in the conceptualization of the study, the project administration and supervision and in reviewing/editing of the manuscript. Dr. Md. Ariful Islam was involved in the conceptualization of the study and reviewing/editing of the manuscript. Dr. Salauddin Al Azad was involved in the conceptualization of the study, the training and supervision of the survey staff, data curation and reviewing/editing of the manuscript. Salwa Islam was involved in conceptualization of the study, funding acquisition and reviewing/editing of the final manuscript. Dr. Md. Ariful Islam was responsible for the conceptualization of the study, funding acquisition, project administration, supervision, and reviewing/editing of the final manuscript.

Funding

The research received no funding from any institution, organization, and even individual sponsor.

Availability of data and materials

All necessary data are properly conserved by the corresponding author, which will be shared upon reasonable request with the journal authority.

Declarations

Ethics approval and consent to participate

The Jessore Medical College Hospital Ethics Committee issued the official ethical approval to the study (Code No. EA0021/2022–2023, Phase-1A/BMDC25), and all its techniques were carried out in compliance with the applicable regulations and guidelines of the Declaration of Helsinki and the ethical requirements for human experimentation. At the start of the survey, all subjects were asked if they would be willing to participate in the study, and the study's goals were fully stated to them. The information that was gathered was kept private and was solely utilized to further the goals of the study. The

surveys also excluded any personal information or other means of identification from the subjects. Study populations were offered the option to either stay in the study or leave at any moment.

Competing interests
The authors declare that they have no competing interests.

Author details
[1]Department of Orthopedic Surgery, Yan'an Hospital Affiliated to Kunming Medical University, Kunming, Yunnan, China. [2]Department of Public Health, Atish Dipankar University of Science & Technology, Dhaka, Bangladesh. [3]James P Grant School of Public Health, BRAC University, 6Th Floor, Medona Tower, Mohakhali, Dhaka 1212, Bangladesh. [4]North South University, Bashundhara, Dhaka 1229, Bangladesh. [5]Noakhali Science and Technology University, Noakhali, Bangladesh. [6]Dhaka Medical College & Hospital, Dhaka 1212, Bangladesh. [7]Bangladesh Medical and Dental College, Dhanmondi, Dhaka 1209, Bangladesh. [8]Department of Microbiology, University of Dhaka, University Street, Nilkhet Rd, Dhaka 1000, Bangladesh. [9]Independent University Bangladesh (IUB), Bashundhrara R/A, Plot#16, Aftabuddin Ahmed Road, Block-B, Dhaka 1229, Bangladesh. [10]Department of Medicine, Dhaka Medical College and Hospital, Dhaka 1000, Bangladesh. [11]Department of Physiotherapy, State College of Health Sciences, Dhanmondi, Dhaka 1209, Bangladesh. [12]National Institution of Social and Preventive Medicine (NIPSOM), National Nutritional Surveillance Project, Mohakhali, Dhaka 1212, Bangladesh. [13]School of Public Health, North China University of Science and Technology, Tangshan, Hebei, People's Republic of China.

Received: 28 June 2023 Accepted: 26 April 2024
Published online: 21 June 2024

References

1. Singh K, Kondal D, Mohan S, Jaganathan S, Deepa M, Venkateshmurthy NS, Jarhyan P, Anjana RM, Narayan KV, Mohan V, Tandon N. Health, psychosocial, and economic impacts of the COVID-19 pandemic on people with chronic conditions in India: a mixed methods study. BMC Public Health. 2021;21:1–5. https://doi.org/10.1186/s12889-021-10708-w.
2. Osailan A. The relationship between smartphone usage duration (using smartphone's ability to monitor screen time) with hand-grip and pinch-grip strength among young people: an observational study. BMC Musculoskelet Disord. 2021;22:1–8. https://doi.org/10.1186/s12891-021-04054-6.
3. Kalirathinam D, Manoharlal MA, Mei C, Ling CK, Sheng TW, Jerome A, Rao US. Association between the usage of smartphone as the risk factor for the prevalence of upper extremity and neck symptoms among university students: a cross-sectional survey based study. Research Journal of Pharmacy and Technology. 2017;10(4):1184–90. https://doi.org/10.5958/0974-360X.2017.00213.X.
4. Hossain A, Proma TS, Raju R, Ahmed S, Islam A. Employment-related musculoskeletal complications experienced by the physical therapists in Bangladesh: a comprehensive cross-sectional case study. Bulletin of Faculty of Physical Therapy. 2022;27(1):36. https://doi.org/10.1186/s43161-022-00096-6.
5. Islam A, Ahmed S, Kamrujjaman M, Akhter S. Effect of physical exercise and routine intervals on LBP assessment using VAS, OLBPDQ, and RMQ among professional motorbike riders in Dhaka city. Journal of Physical Education and Sport. 2020;20(4):1747–53.
6. Mohammad Rashaduzzaman M, Mohammad Kamrujjaman M, Mohammad Ariful Islam MA, Sharmin Ahmed S, Salauddin Al Azad SA. An experimental analysis of different point specific musculoskeletal pain among selected adolescent-club cricketers in Dhaka city. European Journal of Clinical and Experimental Medicine. 2019(4). https://doi.org/10.15584/ejcem.2019.4.4
7. Ali M, Bonna AS, Sarkar AS, Islam MA. SARS-CoV-2 infection is associated with low back pain: findings from a community-based case-control study. Int J Infect Dis. 2022;1(122):144–51. https://doi.org/10.1016/j.ijid.2022.05.050.
8. Reada B, Alshaebi N, Almaghrabi K, Alshuaibi A, Abulnaja A, Alzahrani K. Prevalence and awareness evaluation of De Quervain's tenosynovitis among students in the Kingdom of Saudi Arabia'. International Journal of Pharmaceutical Research & Allied Sciences. 2020;9(4):151–7.
9. Saadat M. Frequency of De Quervain's tenosynovitis in carpenters of Lahore. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2021;1(2):68–75.
10. Ali M, Proma TS, Tasnim Z, Islam MA, Urmi TA, Ahmed S, Sarkar AS, Bonna AS, Khan US. Parental COVID-19 vaccine hesitancy for children with neurodevelopmental disorders: a cross-sectional survey. Tropical Medicine and Health. 2022;50(1):24. https://doi.org/10.1186/s41182-022-00415-6.
11. Hosen I, Al Mamun F, Sikder MT, Abbasi AZ, Zou L, Guo T, Mamun MA. Prevalence and associated factors of problematic smartphone use during the COVID-19 pandemic: a Bangladeshi study. Risk management and healthcare policy. 2021;13:3797–805. https://doi.org/10.2147/RMHP.S325126.
12. Iyengar K, Upadhyaya GK, Vaishya R, Jain V. COVID-19 and applications of smartphone technology in the current pandemic. Diabetes Metab Syndr. 2020;14(5):733–7.
13. Iqbal S, Khattak HG, Aman S, Anwar K, Ali B, Malakandi HB. Frequency of De-Quervain syndrome in mobile users among undergraduate students of Allied Health Sciences Peshawar. Foundation University Journal of Rehabilitation Sciences. 2021 Jan 15;1(1):15–8. https://doi.org/10.33897/fujrs.v1i1.229
14. Woo EH, White P, Lai CW. Musculoskeletal impact of the use of various types of electronic devices on university students in Hong Kong: an evaluation by means of self-reported questionnaire. Man Ther. 2016;1(26):47–53. https://doi.org/10.1016/j.math.2016.07.004.
15. Ashrafi-Rizi H, Najafi NS, Kazempour Z, Taheri B. Research self-efficacy among students of Isfahan University of Medical Sciences. Journal of education and health promotion. 2015;4:26. https://doi.org/10.4103/2277-9531.154117.
16. Mazhar T, Riaz S, Riaz S, Batool A, Khan A, Khan S. De Quervain's tenosynovitis and thumb pain in physiotherapists practicing manual therapy: prevalence and associated factors. Biomedica. 2023;39(1):38–43. https://doi.org/10.24911/BioMedica/5-846.
17. Yeom JW, Koh KH, Park MJ, Choi SJ, Lee KW, Lee HI. Modified staged Finkelstein test for the identification of intracompartmental septum in patients with De Quervain's disease. J Hand Surg Asian Pac. 2021;26(04):555–62. https://doi.org/10.1142/S2424835521500521.
18. Padula WV, Gibbons RD, Pronovost PJ, Hedeker D, Mishra MK, Makic MB, Bridges JF, Wald HL, Valuck RJ, Ginensky AJ, Ursitti A. Using clinical data to predict high-cost performance coding issues associated with pressure ulcers: a multilevel cohort model. J Am Med Inform Assoc. 2017;24(e1):e95–102. https://doi.org/10.1093/jamia/ocw118.
19. Akter KM, Tushi T, Jahan Mily S, Mohona RA, Anis S, Chakraborty AK, Tabassum E, Islam TU, Akhi OJ, Nishe IS, Laxy BN. RT-PCR mediated identification of SARS-CoV-2 patients from particular regions of Bangladesh and the multi-factorial analysis considering their pre and post infection health conditions. Biotechnology Journal International. 2020;24(6):43–56. https://doi.org/10.9734/bji/2020/v24i630121.
20. Al Azad S, Ahmed S, Biswas P, Mia MA, Farjana M, Arshe FA, Mily SJ, Ankhi AB, Shaikat MM, Sultana S. Quantitative analysis of the factors influencing IDA and TSH downregulation in correlation to the fluctuation of activated vitamin D3 in women. J Adv Biotechnol Exp Ther. 2022;5(2):320–33. https://doi.org/10.5455/jabet.2022.d118.
21. Al Azad S, Farjana M, Mazumder B, Abdullah-Al-Mamun M, Haque AI. Molecular identification of a Bacillus cereus strain from Murrah buffalo milk showed in vitro bioremediation properties on selective heavy metals. Journal of advanced veterinary and animal research. 2020;7(1):62. https://doi.org/10.5455/javar.2020.g394.
22. Arefin A, Ema TI, Islam T, Hossen MS, Islam T, Al Azad S, Badal MN, Islam MA, Biswas P, Alam NU, Islam E. Target specificity of selective bioactive compounds in blocking α-dystroglycan receptor to suppress Lassa virus infection: an in silico approach. J Biomed Res. 2021;35(6):459. https://doi.org/10.7555/JBR.35.20210111.
23. Al Azad S, Moazzem Hossain K, Rahman SM, Al Mazid MF, Barai P, Gazi MS. In ovo inoculation of duck embryos with different strains of Bacillus cereus to analyse their synergistic post-hatch anti-allergic potentialities. Veterinary medicine and science. 2020;6(4):992–9. https://doi.org/10.1002/vms3.279.
24. Ferdausi N, Islam S, Rimti FH, Quayum ST, Arshad EM, Ibnat A, Islam T, Arefin A, Ema TI, Biswas P, Dey D. Point-specific interactions of isovitexin

with the neighboring amino acid residues of the hACE2 receptor as a targeted therapeutic agent in suppressing the SARS-CoV-2 influx mechanism. Journal of Advanced Veterinary and Animal Research. 2022;9(2):230. https://doi.org/10.5455/javar.2022.i588.
25. Nipun TS, Ema TI, Mia MA, Hossen MS, Arshe FA, Ahmed SZ, Masud A, Taheya FF, Khan AA, Haque F, Al AS. Active site-specific quantum tunneling of hACE2 receptor to assess its complexing poses with selective bioactive compounds in co-suppressing SARS-CoV-2 influx and subsequent cardiac injury. Journal of Advanced Veterinary and Animal Research. 2021;8(4):540. https://doi.org/10.5455/javar.2021.h544.
26. Paul PK, Al Azad S, Rahman MH, Farjana M, Uddin MR, Dey D, Mahmud S, Ema TI, Biswas P, Anjum M, Akhi OJ. Catabolic profiling of selective enzymes in the saccharification of non-food lignocellulose parts of biomass into functional edible sugars and bioenergy: an in silico bioprospecting. Journal of Advanced Veterinary and Animal Research. 2022;9(1):19. https://doi.org/10.5455/javar.2022.i565.
27. Dey D, Paul PK, Al Azad S, Al Mazid MF, Khan AM, Sharif MA, Rahman MH. Molecular optimization, docking, and dynamic simulation profiling of selective aromatic phytochemical ligands in blocking the SARS-CoV-2 S protein attachment to ACE2 receptor: an in silico approach of targeted drug designing. Journal of advanced veterinary and animal research. 2021;8(1):24. https://doi.org/10.5455/javar.2021.h481.
28. Sharif MA, Hossen M, Shaikat MM, Haidary F, Ema TI, Dey D, Paul PK, Al azad SA, Al Mazid MF, Badal M. Molecular optimization, docking and dynamic simulation study of selective natural aromatic components to block E2-CD81 complex formation in predating protease inhibitor resistant HCV influx. International Journal of Pharmaceutical Research (09752366). 2021 APR 1;13(2). https://doi.org/10.31838/ijpr/2021.13.02.408
29. Islam R, Akter KM, Rahman A, Khanam NN, Azad SA, Islam MR, Farjana M, Rahman MH, Badal MN, Ahmed S. The serological basis of the correlation between iron deficiency anemia and thyroid disorders in women: a community based study. Journal of Pharmaceutical Research International. 2021;33(19A):69–81. https://doi.org/10.9734/jpri/2021/v33i19A31330.
30. Rahman MH, Al Azad S, Uddin MF, Farzana M, Sharmeen IA, Kabbo KS, Jabin A, Rahman A, Jamil F, Srishti SA, Riya FH. WGS-based screening of the co-chaperone protein DjlA-induced curved DNA binding protein A (CbpA) from a new multidrug-resistant zoonotic mastitis-causing Klebsiella pneumoniae strain: a novel molecular target of selective flavonoids. Mol Diversity. 2023;30:1–22. https://doi.org/10.1007/s11030-023-10731-6.
31. Jabin A, Uddin MF, Al Azad S, Rahman A, Tabassum F, Sarker P, Morshed AH, Rahman S, Raisa FF, Sakib MR, Olive AH. Target-specificity of different amyrin subunits in impeding HCV influx mechanism inside the human cells considering the quantum tunnel profiles and molecular strings of the CD81 receptor: a combined in silico and in vivo study. In Silico Pharmacology. 2023;11(1):8. https://doi.org/10.1007/s40203-023-00144-6.
32. Morshed AH, Al Azad S, Mia MA, Uddin MF, Ema TI, Yeasin RB, Srishti SA, Sarker P, Aurthi RY, Jamil F, Samia NS. Oncoinformatic screening of the gene clusters involved in the HER2-positive breast cancer formation along with the in silico pharmacodynamic profiling of selective long-chain omega-3 fatty acids as the metastatic antagonists. Mol Diversity. 2022;29:1–22. https://doi.org/10.1007/s11030-022-10573-8.
33. Bendezu-Quispe G, Soriano-Moreno AN, Urrunaga-Pastor D, Venegas-Rodríguez G, Benites-Zapata VA. Asociación entre conocimientos acerca del cáncer de cuello uterino y realizarse una prueba de Papanicolaou en mujeres peruanas. Revista peruana de medicina experimental y salud pública. 2020 Jun 8;37:17–24. https://doi.org/10.17843/rpmesp.2020.371.4730
34. Morgan SD, Sivakumar BS, An VG, Sevao J, Graham DJ. A review of De Quervain's stenosing tenovaginitis in the context of smartphone use. J Hand Surg Asian Pac. 2020;02:133–6. https://doi.org/10.1142/S2424835520300029.
35. Alexander M, Forastiere L, Gupta S, Christakis NA. Algorithms for seeding social networks can enhance the adoption of a public health intervention in urban India. Proc Natl Acad Sci. 2022;119(30): e2120742119. https://doi.org/10.1073/pnas.2120742119.
36. Katz M, Nandi N. Social media and medical education in the context of the COVID-19 pandemic: scoping review. JMIR Medical Education. 2021;7(2):e25892. https://doi.org/10.2196/25892.
37. Tahir M, Ahmad A. Frequency of De Quervains syndrome among smartphone users in different universities of Lahore, Pakistan. Pakistan Journal of Physical Therapy (PJPT). 2018:10–4.
38. Long J, Liu TQ, Liao YH, Qi C, He HY, Chen SB, Billieux J. Prevalence and correlates of problematic smartphone use in a large random sample of Chinese undergraduates. BMC Psychiatry. 2016;16(1):1–2. https://doi.org/10.1186/s12888-016-1083-3.
39. Sarfraz H, Waseem I, Arslan SA, Ahmed A, Adeel B, Rashid I. The prevalence of De Quervain's tenosynovitis and its association with mobile texting among the university students: prevalence of De Quervain's tenosynovitis and its association with mobile texting. Pakistan BioMedical Journal. 2022 Sep 30:41–5. https://doi.org/10.54393/pbmj.v5i9.682
40. Marengo D, Sariyska R, Schmitt HS, Messner EM, Baumeister H, Brand M, Kannen C, Montag C. Exploring the associations between self-reported tendencies toward smartphone use disorder and objective recordings of smartphone, instant messaging, and social networking app usage: correlational study. J Med Internet Res. 2021;23(9): e27093. https://doi.org/10.2196/27093.
41. Ahmed N, Iftikhar HY, Javed R, Warda T, Samad S. Occurrence of De Quervain's tenosynovitis and its association with short message service texting habit: a cross-sectional study in the general population of Karachi, Pakistan. International Archives of BioMedical And Clinical Research. 2019;5(1):7–11. https://doi.org/10.21276/iabcr.2019.5.1.03
42. Baabdullah A, Bokhary D, Kabli Y, Saggaf O, Daiwali M, Hamdi A. The association between smartphone addiction and thumb/wrist pain: a cross-sectional study. Medicine. 2020 Mar;99(10). https://doi.org/10.1097/MD.0000000000019124
43. Shen PC, Chang PC, Jou IM, Chen CH, Lee FH, Hsieh JL. Hand tendinopathy risk factors in Taiwan: a population-based cohort study. Medicine. 2019 Jan;98(1). https://doi.org/10.1097/MD.0000000000013795
44. Fischer-Grote L, Kothgassner OD, Felnhofer A. Risk factors for problematic smartphone use in children and adolescents: a review of existing literature. Neuropsychiatrie. 2019;33(4):179. https://doi.org/10.1007/s40211-019-00319-8.
45. Zirek E, Mustafaoglu R, Yasaci Z, Griffiths MD. A systematic review of musculoskeletal complaints, symptoms, and pathologies related to mobile phone usage. Musculoskeletal Science and Practice. 2020;1(49): 102196. https://doi.org/10.1016/j.msksp.2020.102196.
46. Marino C, Canale N, Melodia F, Spada MM, Vieno A. The overlap between problematic smartphone use and problematic social media use: a systematic review. Curr Addict Rep. 2021;7:1–2. https://doi.org/10.1007/s40429-021-00398-0.

Publisher's Note